U.S. Department
of Transportation

United States
Coast Guard

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16710/P008079
Serial: H1-0200397
March 12, 2002

From: Commanding Officer, Coast Guard Marine Safety Center
To: Commanding Officer, Coast Guard Marine Safety Office Detroit

Subj: J. W. WESTCOTT II
      45' x 14.5' x 4.4' Uninspected Pilot Boat
      Casualty Analysis

Ref: (a) Phoncon of October 30, 2001 between LCDR Wiest and LCDR Hall of MSO Detroit

As requested in reference (a), we evaluated the stability characteristics of the J. W. WESTCOTT II, which capsized in the Detroit River on October 23, 2001 while conducting a pilot transfer with the tank ship SIDSEL KNUTSEN. We also examined the flooding rates of the port cargo door in both the opened and closed positions and the flooding rate of the hole in the port bilge vent.

CONCLUSIONS

1. The J. W. WESTCOTT II had positive GM and sufficient freeboard prior to executing the transfer operation.

2. Subsequent water on the main deck and progressive flooding into the pilothouse and engine room reduced the vessel's GM and freeboard placing the vessel in a critical condition.

3. The cargo door's lack of a weather tight seal and the hole in the bilge vent contributed to the capsizing of the vessel.

METHOD OF ANALYSIS

1. On November 8th and 9th, 2001 hull offsets were measured by LT Rosello, LT Ray, and LT O'Mara at Nicholson's Dock in Ecorse, Michigan. Using these offsets a computer model of the J.W. WESTCOTT II was generated with the software program General Hydrostatics (GHS). On December 10, 2001 the salvaged vessel was hoisted by a crane and determined to weigh 30,900 lbs (13.79 LT). The lightship weight determined by our computer model varied only 1.3 % from the measured weight of the vessel. This comparison indicates that the computer-generated model satisfactorily approximated the actual vessel.

2. The following four stability scenarios were evaluated cumulatively: The initial condition, six inches of water on the fore and port deck, three feet of water in the pilothouse, and 10% flooding of the engine room. Six inches of water on deck was used in the second scenario because of the height of the coaming on the cargo door. Enclosure (1) contains the tabulated results of the vessels stability in the three progressive flooding conditions.

3. Flooding rate calculations for the cargo door and bilge vent hole were based upon water velocity, hydrostatic head and approximate areas of the openings. The non-tight area at the bottom of the closed cargo door was 0.24 square feet. Although the cargo door sides were also

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non-watertight, flooding through the sides was not included in the calculations. The calculations do not account for progressive flooding between the pilothouse, engine room, and aft compartment of the vessel. The area for the open cargo door was approximated to be 3.67 square feet. This assumes an opening approximately 2 feet high with the cargo door half open. Enclosure (2) contains the approximate flooding rate data.

4. A three-dimensional animation, enclosure (3), of the initial transfer scenario was developed using 3D Studio Max software. This animation provided a visual representation of the significant size difference of the vessels. It should not be used to speculate on the rollover behavior of the vessel.

FINDINGS

1. The J. W. WESTCOTT II is an un-inspected vessel under Coast Guard regulations and was not subject to regulatory stability standards. However, in the initial condition, the J. W. WESTCOTT II had positive stability and met the intact stability criteria of 46 CFR Subchapter S for vessels operating on protected routes. In this condition, the vessel had a GM of 7.04 feet, a freeboard of approximately 2 feet, no heel, and slight aft trim.

2. Six inches of accumulated water on the fore and port decks reduced the GM to 3.0 feet. The vessel still maintained a freeboard of approximately 2.9 inches with positive righting arms.

3. The lack of weather tight integrity around the cargo door allowed progressive flooding into the pilothouse. Three feet of water in the pilothouse submerged the deck edge by approximately a foot. In addition, the hole in the bilge vent allowed flooding directly into the engine room.

4. The scope of this analysis was insufficient to determine the dynamic forces acting on the J. W. WESTCOTT II due to the interaction of the two vessels in close proximity.

5. Volumetric analysis based on the combined minimum effects of water velocity and hydrostatic head resulted in flooding a time of approximately 3 minutes to attain 3 feet of water in the pilothouse. This rate was based upon the cargo door being closed. If the cargo door was open the pilothouse would have flooded in less than 1 minute. See Table 7 of Enclosure (2).

If you have any questions or need additional assistance in this matter, please feel free to contact the project officer, Lieutenant Brad Rosello, at the above number.

A. L. PEEK

Encl: (1) Summary of GHS Output Stability Characteristics of the J.W. WESTCOTT II
(2) Flooding Rate Approximations
(3) Animation of J. W. WESTCOTT II pilot transfer with SIDSEL KNUTSEN

J.W. WESCOTT II
Stability Characteristics

Stability Summary					
Conditions of Flooding	GMt (FS cor.) (Feet)	Least Freeboard (Feet)	Equilibrium Heel Angle (Degrees)	Freeboard Height to Cargo Door (Feet)	Water on Board (Gallons)
Initial	7.04 ft	2.09 ft	0.0°	2.95 ft	0 gal
Plus Water on Deck	3.00 ft	0.24 ft	13.88°	1.45 ft	1396 gal
Plus Water in Pilot House	1.83 ft	-0.93 ft	15.71°	0.28 ft	4664 gal
Plus Water in Engine Room	1.71 ft	-1.10 ft	16.26°	0.12 ft	4999 gal

Enclosure (1)

J.W. WESTCOTT II
Flooding Rate Approximations

Table 1

GHS Compartment	Weight (Long Tons)	Weight (Pounds)	Density (Pounds per Cubic Foot – lbs/ft³)	Volume (Gallons)
Fwd Collision Blkhd	1.30 lton	2912.00 lbs	62.40 lbs/ft³	349.09 gal
Fwd Void	11.41 lton	25558.40 lbs	62.40 lbs/ft³	3063.94 gal
Aft Compartment	17.91 lton	40118.40 lbs	62.40 lbs/ft³	4809.40 gal
Fuel Tank Port	0.72 lton	1612.8 lbs	62.40 lbs/ft³	193.34 gal
Fuel Tank Stbd	0.72 lton	1612.8 lbs	62.40 lbs/ft³	193.34 gal
Engine Room	10.15 lton	22736.00 lbs	62.40 lbs/ft³	2725.59 gal
Pilot House	21.13 lton	47331.20 lbs	62.40 lbs/ft³	5674.07 gal

Space Volume by GHS Hull Model

Table 2

Source	Width (Inches)	Length (Inches)	Cross Sectional Area (Square Inches – in²)	Cross Sectional Area (Square Feet – ft²)
Closed Cargo Door	0.75 in	46 in	34.5 in²	0.24 ft²
Open Cargo Door	23 in	23 in	529 in²	3.67 ft²
Hole in Port-Side Bilge Vent	1 in	1 in	1 in²	0.007 ft²

Downflooding Source Cross Sectional Areas

Table 3

Cross Sectional Area (Square Feet - ft²)	Water Velocity (Knots)	Water Velocity (Feet per Second)	Water Volumetric Flow Rate (Gallon per Minute – gal/min)	Time to Fill Pilot House with Water (Minutes)	Time to Accumulate 3 Feet of Water in Pilot House (Seconds)
3.67 ft²	10.00 kts	16.88 ft/sec	27804.26	0.09 min	5.18 sec
3.67 ft²	9.00 kts	15.19 ft/sec	25023.84	0.10 min	5.76 sec
3.67 ft²	8.00 kts	13.50 ft/sec	22243.41	0.11 min	6.48 sec
3.67 ft²	7.00 kts	11.81 ft/sec	19462.98	0.12 min	7.40 sec
3.67 ft²	6.00 kts	10.13 ft/sec	16682.56	0.14 min	8.64 sec
3.67 ft²	5.00 kts	8.44 ft/sec	13902.13	0.17 min	10.37 sec
3.67 ft²	4.00 kts	6.75 ft/sec	11121.70	0.22 min	12.96 sec
3.67 ft²	3.00 kts	5.06 ft/sec	8341.28	0.29 min	17.28 sec
3.67 ft²	2.00 kts	3.38 ft/sec	5560.85	0.43 min	25.92 sec

Open Cargo Door Flow Rates by Water Velocity

Enclosure (2)

J.W. WESTCOTT II
Flooding Rate Approximations

Table 4

Closed Cargo Door Flow Rates by Water Velocity				
Cross Sectional Area (Square Feet - ft²)	Water Velocity (Knots)	Water Velocity (Feet per Second)	Water Volumetric Flow Rate (Gallons per Minute – gal /min)	Time to Accumulate 3 Feet of Water in Pilot House (Minutes)
0.024 ft²	10.00 kts	16.88 ft/sec	1813.32 gal/min	1.32 min
0.024 ft²	9.00 kts	15.19 ft/sec	1631.99 gal/min	1.47 min
0.024 ft²	8.00 kts	13.50 ft/sec	1450.66 gal/min	1.66 min
0.024 ft²	7.00 kts	11.81 ft/sec	1269.32 gal/min	1.89 min
0.024 ft²	6.00 kts	10.13 ft/sec	1087.99 gal/min	2.21 min
0.024 ft²	5.00 kts	8.44 ft/sec	906.66 gal/min	2.65 min
0.024 ft²	4.00 kts	6.75 ft/sec	725.33 gal/min	3.31 min
0.024 ft²	3.00 kts	5.06 ft/sec	544.00 gal/min	4.42 min
0.024 ft²	2.00 kts	3.38 ft/sec	362.66 gal/min	6.62 min

Table 5

Closed Cargo Door Flow Rates by Hydrostatic Head		
Water (Hydrostatic Head) Height (Feet)	Water Volumetric Flow Rate (Gallons per Minute)	Time to Accumulate 3 Feet of Water in Pilot House (Minutes)
2.00 ft	1219.30 gal/min	1.97 min
1.80 ft	1156.73 gal/min	2.08 min
1.60 ft	1090.57 gal/min	2.20 min
1.40 ft	1020.14 gal/min	2.35 min
1.20 ft	944.46 gal/min	2.54 min
1.00 ft	862.17 gal/min	2.79 min
0.80 ft	771.15 gal/min	3.11 min
0.60 ft	667.84 gal/min	3.60 min
0.40 ft	545.29 gal/min	4.41 min
0.20 ft	385.58 gal/min	6.23 min

Enclosure (2)

J.W. WESTCOTT II
Flooding Rate Approximations

Table 6

Bilge Vent Hole Flow Rates by Hydrostatic Head						
Water (Hydrostatic Head) Height (Feet)	Cross Sectional Area (A) (Square Feet - ft^2)	Water Velocity (V) (Feet per Second – ft/sec)	Water Volumetric Flow Rate (Q=(A)(V)) Cubic Feet per Second – ft^3/sec)	Water Volumetric Flow Rate (Q=(A)(V) (Gallons per Minute – gal/min)	Percentage of Engine Room Full after 3.21 Minutes of Flooding (Percent - %)	Volume of Water in Engine Room after 3.21 Minutes of Flooding (Gallons)
2.00	0.083	11.35	0.95	424.10	49.95	1361.37
1.80	0.083	10.77	0.90	402.34	47.38	1291.51
1.60	0.083	10.15	0.85	379.33	44.67	1217.65
1.40	0.083	9.50	0.79	354.83	41.79	1139.00
1.20	0.083	8.79	0.73	328.51	38.69	1054.51
1.00	0.083	8.02	0.67	299.89	35.32	962.63
0.80	0.083	7.18	0.60	268.23	31.59	861.01
0.60	0.083	6.22	0.52	232.29	27.36	745.65
0.40	0.083	5.08	0.42	189.66	22.34	608.82
0.20	0.083	3.59	0.30	134.11	15.79	430.50
0.08	0.083	2.32	0.19	86.55	10.19	277.83

Table 7

Cumulative Flooding Rate – Closed Cargo Door		
Conditions	Water Volumetric Flow Rate	Time to Accumulate 3 Feet of Water in Pilot House
Water Velocity = 2 Knots and 0.2 Feet of Hydrostatic Head	748.24 gallons/minute	3.21 minutes

Enclosure (2)